

The economics and demography of aging

Dora L. Costa*

Department of Economics, Massachusetts Institute of Technology, E52-274C, 50 Memorial Drive, Cambridge, MA 02142

This issue of PNAS brings together a collection of six papers concerning the economics and demography of aging, written in honor of Robert Fogel's 80th birthday. Robert Fogel is the Charles R. Walgreen Distinguished Service Professor of American Institutions and the director of the Center for Population Economics in the University of Chicago Graduate School of Business. The preeminent economic historian of our time, he received the Nobel Prize in Economics in 1993 for his applications of economic theory and quantitative methods to explain economic and institutional change.

Since the mid-1980s, Robert Fogel's work has focused on understanding long-run changes in the physiology of aging in the United States. He has argued that recent increases in longevity and in health are too rapid to have been caused by genetic or evolutionary change and that explanations should focus on changes in the physical environment (1–4). Nutritional intake has improved, and the demands on that intake by disease, work, and climate have fallen, thanks to economic growth, technological change, investments in public health, and greater scientific knowledge. Some of these changes have had immediate effects on older-age mortality and morbidity, but others have had lagging effects because, as a growing body of evidence indicates (5–8), health at older ages depends both on early childhood health and on maternal health.

Robert Fogel is one of many economists whose interest in health and longevity has created an entirely new subfield, referred to simply as the economics of aging, with its own separate conferences that draw researchers from a variety of the more traditional subfields, such as labor economics, public finance, and economic history. Policy considerations and new governmental funding have spurred economists' interest in this new subfield. A baby bust followed the baby boom of 1945–1964 while rising life expectancy led to an increase in the share of the population over age 65, straining social security pension and health-care systems.

The sharp acceleration in life expectancy at older ages began in the late 1960s. Although evident at all older ages, the life expectancy pattern at age 85 is particularly striking. Life expectancy at age 85 rose by almost 2 years in the United States, England and Wales, Sweden, and

France between 1960 and the end of the 20th century after having risen by only ≈ 1 year between 1900 and 1960 (see the Human Mortality Database and the Berkeley Mortality Database, www.demog.berkeley.edu; all life expectancies are period life expectancies).

On the whole, the recent increase in life expectancy has been accompanied by declines in disability and functional limitations at older ages (for a review, see ref. 9). Over the 20th century as a whole, the rate of improvements in functional limitations has accelerated (10). At the beginning of the 20th century, older men were less able to walk, bend, see, and hear than men today, and they were much more likely to suffer from respiratory problems, valvular heart disease, arteriosclerosis, and joint and back problems (3, 10, 11). This generation suffered from severely debilitating infectious disease, chronic malnutrition, and heavy manual labor.

Developed nations have now achieved a historically unprecedented degree of control over their physical environment. However, our very success has left us with new issues with which researchers need to grapple. These issues include (i) reducing persistent health disparities and (ii) financing health care and retirement. Socioeconomic status and health are strongly associated, and understanding the relationship between them will help us to improve the health of the disadvantaged. Improving population health and longevity, combined with the growing value to consumers of retirement and of health care, has strained our current systems for financing health care and retirement.

The six papers in this issue of PNAS examine the relationship between health and economic growth, the importance of early life factors to healthy aging, the impact of socioeconomic status on health, and how to finance retirement for a growing elderly population without imposing too many burdens on the young. These topics are still much debated not just among economists but also among medical researchers, biologists, epidemiologists, and demographers. Economic historians such as Robert Fogel have contributed to health research by describing long-run changes and putting them in context. Such descriptions have given all health researchers a better understanding of the relationships among the choices we

make, the environment, initial health, and luck.

Robert Fogel's work has documented the large inequalities in the physical environment that prevailed in the past. Around 1890, there were 317 more infant deaths per 1,000 in the worst wards of large cities than in the best wards. These severe intraurban disparities in infant mortality rates were reduced by 84% by 1950 and continued to decline during the balance of the 20th century (1, 2, 12, 13). On the whole, the problems of food, shelter, clean water, and clean milk that destroyed the health of the poor have been solved in developed nations, and the challenge now is to improve the nonmaterial environment of the poor. According to Fogel (2, 13), the children of the slums often lack a vision of opportunity, a sense of family and community, a work ethic, a sense of discipline, and a thirst for knowledge.

In one of the papers in this special feature (14), James Smith examines the relationship between socioeconomic status and health for the specific case of diabetes. He shows that the less educated are at slightly greater risk of contracting the disease, are at greater risk of having their diabetes undiagnosed, and have greater difficulty in managing the treatments necessary to control the disease. As treatments have become more complex, the socioeconomic gradient in successful management of diabetes has increased.

Education, as Smith shows, affects health. James Heckman (15) stresses that noncognitive abilities such as persistence, motivation, self-control, risk aversion, and willingness to delay gratification determine later educational outcomes because they make investments in education easier. These noncognitive abilities are formed very early in life and are very hard to change after adolescence.

Although income by itself plays some role in explaining socioeconomic disparities (after all, clean water is costlier than dirtier water) the effects of income are, in general, often weak. Angus Deaton (16) examines heights, childhood mortality, and income in 43 developing

Author contributions: D.L.C. wrote the paper.

The author declares no conflict of interest.

*To whom correspondence should be addressed. E-mail: costa@mit.edu.

© 2007 by The National Academy of Sciences of the USA

countries and argues that there is no clear-cut relationship between height and income across countries. African women continue to be very tall despite declining and very low African incomes and despite very high child mortality. By looking at differential income declines across the U.S. during the Great Depression and the Dust Bowl, David Cutler, Grant Miller, and Douglas Norton (17) investigate whether changes in economic conditions experienced *in utero* affect health at older ages. They find no effects, suggesting that researchers seeking explanations for declining disability rates among the elderly today need to examine factors other than income.

Public-health improvements, many of which were already in place by the Great Depression, may explain the declining disability rates among the elderly observed today. Dora Costa, Lorens Helmchen, and Sven Wilson (18) find that older black men around 1910 had very high rates of arteriosclerosis relative to whites and trace their poorer health status at ages 60–74 to their greater life-long incidence of infectious disease. Public-health benefits accrued later to the black population than to the white population, which may explain some of the persistence of black/white health disparities at older ages.

James Poterba, Steven Venti, and David Wise (19) move away from health to examine the economic ramifications of population aging by investigating how changes in types of pension plans and in demographic structure will affect the wealth of future retirees. They find that the continuation of pension-plan shifts away from traditional defined benefit plans and to 401(k) plans will lead to large increases in retirement wealth even if rates of return on financial assets are below their historical pattern.

The six papers in this issue of PNAS are all empirical studies. Fogel (20) has stressed that in recent years, economics has become imbalanced, leading to “a superabundance of theorizing about behavior, suggested by exceedingly sparse evidence, and sometimes by no evidence at all, just by someone else’s unsubstantiated theory.” He does not denigrate the role of theory, emphasizing that in another era, “the progress of understanding has been impeded not by excessive enthusiasm for theory but by a failure to recognize its essential role in sound empirical research.” What is needed is an iterative process of theoretical conceptualization, data creation, analysis, and reconceptualization. Models identify the kinds of data that need to be examined. However, for processes that are poorly understood, exploratory data analysis along the lines suggested by Tukey (21), Hoaglin *et al.* (22, 23), and others elaborates, qualifies, revises, and replaces the provisional hypotheses suggested by models.

Few mathematical models apply strictly to actual social behavior, and even the best data are biased and incomplete. Extracting useful information from data requires understanding the processes that generated the data, including the procedures followed during data collection and the history of the institution or event under study. The choice of estimating procedure depends heavily on the object of the investigation. The data need to be probed not just in one way but in several different ways. Only then can we be certain that a finding is robust. Robert Fogel learned these lessons from his teacher Simon Kuznets (24), and he has imparted them to his many students over the years.

The success of the “full-information” approach to hypothesis testing advocated by Fogel (20) depends on the capacity to retrieve the evidence needed for a detailed and reliable description of the processes under investigation. This capacity to retrieve information has been provided by large public investments in data creation. None of the six papers could have been written without these investments. The data used include the Health and Retirement Survey (Cutler), the Survey of Income and Program Participation (Poterba, Venti, and Wise), the Demographic and Health Surveys (Deaton), the National Health and Nutrition Examination Surveys (Smith), the National Longitudinal Survey of Youth (Heckman), and data on the Aging of Union Army veterans created by Robert Fogel (Costa, Helmchen, and Wilson). This last data set is one of Robert Fogel’s crowning contributions to the field of aging because it has permitted researchers to examine how aging has changed across cohorts. The data contain >15,000 variables, ranging from occupation to health to residence detailing the life histories of 39,000 white and 6,000 black Union Army veterans followed from early childhood to death and coded from hand-written, free-form administrative, medical, and census records. Although such data creation is costly and often falls victim to budget cuts, without such data, our analyses could not distinguish between transient and long-run trends, and economics would become a set of elegant theories based on little evidence.

This work was supported in part by National Institute on Aging/National Institutes of Health (NIH) Grant 1 R13 AG029059-01. D.L.C. was supported by NIH Grants P01 AG10120 and R01 AG19637.

1. Fogel RW (2004) *The Escape from Hunger and Premature Death 1700–2100: Europe, America, and the Third World* (Cambridge Univ Press, Cambridge, UK).
2. Fogel RW (1999) *Am Econ Rev* 89:1–21.
3. Fogel RW (1994) *Am Econ Rev* 84:369–395.
4. Fogel RW, Costa DL (1997) *Demography* 34:49–66.
5. Barker DJP (2003) *The Best Start in Life* (Century, London).
6. Barker DJP (1998) *Mothers, Babies, and Health in Later Life* (Churchill Livingstone, Edinburgh).
7. Barker DJP (1997) *Br Med Bull* 53:96–108.
8. Barker DJP (1992) *Fetal and Infant Origins of Adult Disease* (British Medical Journal Publishing Group, London).
9. Freedman VA, Martin LG, Schoeni RF (2002) *J Am Med Assoc* 288:3137–3146.
10. Costa DL (2002) *Demography* 39:119–137.
11. Costa DL (2000) *Demography* 37:53–72.
12. Fogel RW (2004) National Bureau of Economic Research Working Paper 10311. February (Natl Bureau of Econ Res, Cambridge, MA).
13. Fogel RW (2000) *The Fourth Great Awakening and the Future of Egalitarianism* (Univ of Chicago Press, Chicago).
14. Smith JP (2007) *Proc Natl Acad Sci USA* 104:13225–13231.
15. Heckman JJ (2007) *Proc Natl Acad Sci USA* 104:13250–13255.
16. Deaton A (2007) *Proc Natl Acad Sci USA* 104:13232–13237.
17. Cutler DM, Miller G, Norton DM (2007) *Proc Natl Acad Sci USA* 104:13244–13249.
18. Costa DL, Helmchen LA, Wilson S (2007) *Proc Natl Acad Sci USA* 104:13219–13224.
19. Poterba J, Venti S, Wise DA (2007) *Proc Natl Acad Sci USA* 104:13238–13243.
20. Fogel RW (1992) in *Without Consent or Contract. The Rise and Fall of American Slavery: Evidence and Methods*, eds Fogel RW, Galantine RA, Manning RL (Norton, New York), pp 1–41.
21. Tukey JW (1977) *Exploratory Data Analysis* (Addison-Wesley, Reading, MA).
22. Hoaglin DC, Mosteller F, Tukey JW, eds (1983) *Understanding Robust and Exploratory Data Analysis* (Wiley, New York).
23. Hoaglin DC, Mosteller F, Tukey JW, eds (1985) *Exploring Data Tables, Trends and Shapes* (Wiley, New York).
24. Fogel RW (2001) *National Academy of Sciences: Biographical Memoirs* (Natl Acad Press, Washington, DC), Vol 79.